

REVIEW

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Resuscitation after cardiac surgery awareness: an Egyptian national survey

Moslem Abdelghafar^{1*} , Taher Abdelmoneim², Alaa Mohamed³ and Mohamed Abdalla⁴

Abstract

Background: Cardiac surgery patients have different resuscitative needs than other patients who experience in-hospital cardiac arrest; this was addressed in the guidelines. However, it is unknown how widely the guidelines are practiced, or a training protocol is followed in different cardiac surgery units in Egypt.

Methods: A 21-question survey was created and included: Participant demographics, prevalence of cardiac arrest, cardiac arrest protocol, emergency re sternotomy technique, training protocols. Survey was disseminated through social media messaging platforms during the period between November 2020 and January 2021.

Results: Ninety-five responses were from 11 centres across Egypt. In total, 68.5% of the respondents were surgeons, 76.8% of participants were junior surgeons. For patients who go into VF after cardiac surgery, respondents would attempt a median of 3 shocks with only 24.2% commencing defibrillation shocks before external cardiac massage, whilst the majority initiating CPR immediately and performing emergency re sternotomy in a median time of 10 min. In total, 56.8% would give 1 mg of adrenaline as soon as the cardiac arrest was established. If a surgeon was not available, only 36.8% of respondents would allow any trained personnel to perform the emergency re sternotomy. Only 9.5% practice regularly on emergency sternotomies. Seventy-five percent think tailored training is important and staff should be oriented about it in the future.

Conclusion: An action plan is required to improve the training of the junior surgeons regarding the Cardiac Advanced Life Support Protocol to implement it in a timely organised manner. This should be endorsed and audited by a national society or body by keeping a national registry and mandatory recertification.

Keywords: Cardiac surgery, Resuscitation, Training, Education

Background

Every year, over 250,000 patients have cardiac surgery in some 450 centres in Europe [1] and more than 400,000 patients undergo cardiac surgery in the USA at approximately 1200 medical centres [2–4]. During the past decade, there has been an increasing recognition that cardiac surgery patients have different resuscitative needs than other medical and surgical patients who experience in-hospital cardiac arrest. The special resuscitative needs of cardiac surgery patients were addressed in the 2021

European Resuscitation Council (ERC) Guidelines for Resuscitation in the section reviewing cardiac arrest in special circumstances and the 2020 American Heart Association (AHA) guidelines for cardiopulmonary resuscitation and emergency cardiovascular care in special situations [5, 6]. However, it is unknown how widely the guidelines are practiced, or a training protocol is followed in different units in Egypt. This national survey aims to identify the views and common practice of Egyptian cardiac surgery teams regarding resuscitation after cardiac surgery.

*Correspondence: Moslem_fathy@hotmail.com

¹ Department of Cardiothoracic Surgery, Wythenshawe Hospital, Manchester, UK

Full list of author information is available at the end of the article

Methods and materials

A 21-question survey was created (Table 1) based on the original survey used by the European Association of Cardiothoracic Surgery (EACTS) guidelines committee [7]. Questions included the following topics: Participant demographics, prevalence of cardiac arrest in the intensive care unit, cardiac arrest with ventricular fibrillation or non-shockable rhythm, emergency re sternotomy technique, training and arrest protocols. The survey was modified to collect participants' demographics; other questions remained the same as the original survey. Survey dissemination was targeted to staffing of cardiothoracic departments in various institutes through social media platforms such as mobile messaging applications and emails during the time period between November 2020 and January 2021; this was our preference due to COVID-19 pandemic to allow better reach and in line with social distancing national guidance. Ethics approval and informed consent have been waived by the institutional review board.

Demographics

The first eight questions were used to obtain demographic data on the expertise of the respondent, the size of the unit and the prevalence of cardiac arrest and emergency re sternotomy in the unit where the respondent worked.

Data cleaning

Prior to analysis, the data from all respondents were analysed independently and excluded if the multiple choice, numerical or text responses indicated that the survey had been incorrectly completed or if multiple respondents came from the same email address. Respondents were excluded if there were no responses to over 50% of the questions or if the numerical data responses were impossible (i.e. more arrests than operations performed in that unit).

Statistical analysis

Continuous data are presented as median, mean, standard deviation and range or only as median if the data was significantly skewed using the Kolmogorov–Smirnov test. Categorical data was presented as percentages. Data was presented and analysed using SPSS 13.0 (Statistical Package for the Social Sciences, SPSS Inc., Chicago, USA).

Results

Of 126 responses, 95 were suitable for inclusion. Thirty-one responses were deleted due to duplication or incorrect completion. We have responses from 11 centres across Egypt, 68.5% of the respondents were surgeons whilst cardiac anaesthetists and intensivists formed 12.6% and 18.9% respectively. The majority of participants were non-consultants/middle-grade doctors comprising 76.8%; consultant participation was 23.2%.

The median number of cases performed by all units was 480 and this ranged from 10 to 3000 annually. The average percentage of cardiac arrests in these units was 7%, and the average percentage of emergency re sternotomy after cardiac arrest was 2.4%. Respondents reported that the median survival to hospital discharge of all arrests was 33%.

In patients who arrest with VF or VT, only 24.2% of respondents would commence 1-3 defibrillation shocks and then perform external cardiac massage (ECM), with the majority initiating CPR immediately (Fig. 1).

Regarding the sequence of defibrillation attempts interspersed with ECM, 50.5% of respondents would perform three attempts at defibrillation without intervening ECM. In total, 49.5% would perform single defibrillation attempts interspersed with ECM at 1- or 2-min intervals. In total, 56.8% of respondents would give 1 mg of adrenaline as soon as the cardiac arrest was established. Only 6.3% of respondents thought that it should be given rarely or not at all (Fig. 2).

For patients who go into VF in less than 24 h after cardiac surgery, respondents would attempt a mean of 3 defibrillation shocks and would perform emergency re sternotomy in a median time of 10 min and in 15 min if the rhythm was not VF. Whilst for patients who suffer cardiac arrest more than 24 h after the surgery results were, a median of 5.6 attempts of defibrillation and a median of 17.6 min to perform emergency re sternotomy (Table 2).

A series of questions were asked on the conduct of an emergency re sternotomy in patients who have suffered a cardiac arrest (Table 3). If a surgeon was not immediately available, 36.8% of respondents would allow a suitably trained non-surgeon to perform the emergency re sternotomy whilst 58.9% of respondents would not accept anyone except a surgeon to perform the re sternotomy. Of respondents who would allow a non-surgeon to perform an emergency re sternotomy, 33.7% would allow anyone trained for the procedure to do it, 14.4% would allow an anaesthesiologist, 17.9% would allow intensive care doctor and 12.6% would allow a junior grade doctor to perform an emergency re sternotomy. Only 9.5% and 3.2% would allow a theatre scrub nurse and a senior intensive care nurse respectively to do this.

A total of 49.4% of the participants have never practised any local training to perform an emergency re sternotomy; however, 34.7% believe it is a must-have. Forty-one percent of the respondents state they occasionally practice or talk with the staff about guidance in the event of a cardiac arrest. Only 9.5% practice regularly on emergency re sternotomies.

Twenty-five percent assume that current training is sufficient and does not need modification or additional patient tailoring, whilst 75% think tailored training is important and staff should be encouraged to undertake it in the future.

Table 1 Depicting survey questions

| |
|--|
| Demographics |
| 1- What's your speciality? |
| (a) Cardiothoracic surgeon |
| (b) Cardiac surgery Anesthesiologist |
| (c) Cardiac surgery intensive care specialist |
| |
| 2- What's your degree of expertise? |
| (a) Consultant grade |
| (b) Non consultant/Middle grade/specialist/ in training |
| |
| 3- What's the name of your hospital? |
| |
| Prevalence of cardiac arrest in the intensive care unit |
| |
| 4- How many cardiac surgical procedures did your unit perform in the past 12 months? |
| 5- How many patients in the past 12 months do you estimate required closed chest compressions for cardiac arrest in your cardiac intensive care following cardiac surgery? |
| 6- How many patients in the past 12 months who suffered a cardiac arrest on your cardiac intensive care unit required emergency re-sternotomy as part of the resuscitation? |
| 7- How many patients in the past 12 months who required an emergency re-sternotomy also required a return onto cardiopulmonary bypass? |
| 8- Of all patients who arrested, what percentage of these do you estimate survived to hospital discharge? |
| |
| Cardiac arrest with ventricular fibrillation |
| |
| 9- Regarding patients who go into ventricular fibrillation or pulseless ventricular tachycardia on your cardiac intensive care have you ever experienced successful return to a spontaneous circulation with a precordial thump? |
| (a) I have witnessed one or more successful occasions |
| (b) I have never witnessed this, but I have heard of success in cardiac surgical patients |
| (c) I have never witnessed or heard of success, but I would have a go if I thought it was appropriate |
| (d) I have never witnessed or heard of success and I think that it is benign but of little use |
| (e) I think that this is a potentially harmful manoeuvre and would not condone its use |
| |
| 10- If a patient goes into ventricular fibrillation or pulseless ventricular tachycardia on your cardiac intensive care after cardiac surgery do you think that they should: |
| (a) Receive immediate external chest compressions followed by defibrillation as soon as available |
| (b) Have defibrillation as soon as possible and only commence external chest compression after 1-3 attempts at defibrillation have failed |
| |
| 11- on your unit if a patient goes into ventricular fibrillation or pulseless ventricular tachycardia what is your preferred sequence of defibrillation attempts? |
| (a) I would perform three attempts at defibrillation in a row, then commence chest compressions for 2 min with a single shock after each 2-min cycle |
| (b) I would perform single attempts at defibrillation with external chest compressions for 1 min between attempts |
| (c) I would perform single attempts at defibrillation with external chest compressions for 2 min between attempts |
| (d) I would perform three attempts at defibrillation in a row, with external chest compressions till re-sternotomy |

Table 1 (continued)

| |
|--|
| 12- For patients in established cardiac arrest when do you think that administration of epinephrine (adrenaline) is warranted? |
| (a) As soon as possible |
| (b) after 2 min of external massage |
| (c) After 3-5 min of external massage |
| (d) After 5-10 min of external massage |
| (e) Only after continued cardiac arrest despite emergency re-sternotomy (1) Only in exceptional circumstances and should not be part of routine cardiac arrest management after cardiac surgery |
| |
| 13- If you had to name a number of defibrillation attempts or a rough time at which you felt that a patient less than 24 h after cardiac surgery in ventricular fibrillation should have emergency re-sternotomy what would it be? (number of attempts and number of minutes) |
| |
| 14- If you had to name a number of defibrillation attempts or a rough time at which you felt that a patient MORE than 24 h after cardiac surgery in ventricular fibrillation should have emergency re-sternotomy what would it be? (number of attempts and number of minutes) Cardiac arrest where the rhythm is not VF or pulseless VT. |
| |
| 15- With regard to patients who arrest after cardiac surgery, but the rhythm is not ventricular fibrillation or ventricular tachycardia. In how many minutes should emergency re-sternotomy be performed if the patient is WITHIN 24 h of surgery? |
| |
| 16- With regard to patients who arrest after cardiac surgery, but the rhythm is not ventricular fibrillation or ventricular tachycardia. When should emergency re-sternotomy be performed if the patient is MORE THAN 24 h of surgery? Emergency re-sternotomy technique |
| |
| 17- With regard to emergency chest re-opening |
| (a) A surgeon should always perform this and non-surgeons should never do this |
| (b) If no surgeon is available rapidly then you would be happy for a non-surgeon to perform this if trained to do it |
| (c) If no surgeon is available rapidly then you would be happy for a non-surgeon to perform this even if they have had no formal training |
| |
| 18- In the exceptional circumstance where no surgeon is immediately available to perform the emergency re-sternotomy in an arrest, who would you be happy to do this instead? (multiple responses allowed) |
| (a) An anaesthesiologist |
| (b) A surgeon's assistant |
| (c) A theatre nurse |
| (d) A junior doctor |
| (e) A senior intensive care nurse |
| (f) Nobody except surgeons should do this Training and arrest protocols |
| |
| 19- In your unit do you practice and provide training in the process of emergency chest re-opening with your staff in the intensive care? |
| (a) We never practice, and this is not necessary |
| (b) We never practice this, but this might be a good idea |
| (c) We talk about this informally to our staff and they have experience of this |
| (d) We have occasionally practiced this |
| (e) We regularly practice this |
| |
| 20- With regard to our current guidelines for resuscitation for patients who arrest in the cardiac intensive care unit. |
| (a) I advocate current resuscitation guidelines as proposed by the European Resuscitation Council or the American Heart Association on our unit |
| (b) I do not agree with current resuscitation guidelines and we have our own agreed protocol on our unit |
| (c) I do not agree with current resuscitation guidelines. I would act as I see fit, although we do not have our own agreed protocol on the unit. |
| (d) I have not actually read either of the European resuscitation council or EACTS updated guidelines on resuscitation |
| |
| 21- With regard to staff training for cardiac arrest after cardiac surgery in the intensive care. (a) Current training available is adequate despite it not being tailored to patients after cardiac surgery and no further training is needed in our unit |
| (b) We give additional training tailored to patients after cardiac surgery and no additional training is needed |
| (c) Training tailored to patients after cardiac surgery may be useful for our staff in the future |
| (d) Training tailored to patients after cardiac surgery is important and should be given in the future |

10- RESPONSES IF A PATIENT GOES INTO VF OR VT

- Receive immediate external chest compressions followed by defibrillation
- 1-3 defibrillations followed by external chest compressions

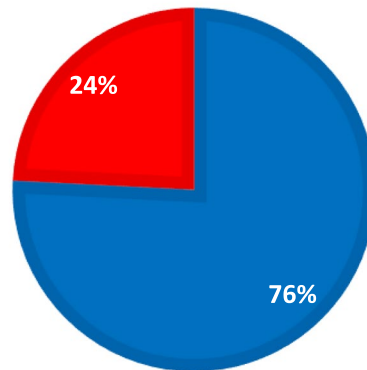


Fig. 1 Percentage of respondents commencing ECM or DC shocks in a VF arrest situation

12- RESPONSES FOR ADRENALINE ADMINISTRATION IN ESTABLISHED CARDIAC ARREST

- As soon as possible
- After 2 min of external massage
- After 3-5 mins of external massage
- After 5- 10 mins of external massage
- Only after sustained cardiac arrest despite emergency sternotomy
- Only in exceptional circumstances and not part of routine cardiac arrest management

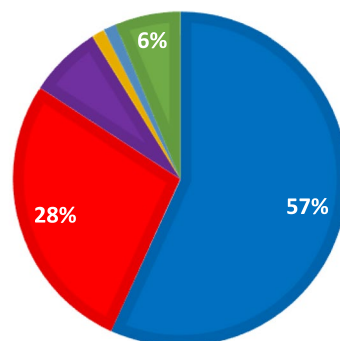


Fig. 2 Adrenaline administration patterns after cardiac arrest

In total, 70.5% of all respondents advocate the current guidelines for resuscitation published by the ERC, EACTS and the AHA for use on their patients; however,

5% disagree with the guidelines and have their own local protocol. Meanwhile, 24.2% have not read the guidelines.

Table 2 Median of defibrillation attempts and time to perform emergency re sternotomy

| | Number of responses | Median | Range |
|---|---------------------|----------|--------------------|
| Number of defibrillation attempts before re sternotomy in VF/VT | | | |
| Cardiac arrest < 24 h | 95 | 3 shocks | 14 (min 1, max 15) |
| Cardiac arrest > 24 h | 95 | 5 shocks | 19 (min 1, max 20) |
| Time to re sternotomy where initial rhythm is VF/VT | | | |
| Cardiac arrest < 24 h | 95 | 10 min | 29 (min 1, max 30) |
| Cardiac arrest > 24 h | 95 | 17.6 min | 58 (min 2, max 60) |
| Time to re sternotomy where initial rhythm is asystole/PEA | | | |
| Cardiac arrest < 24 h | 95 | 15 min | 44 (min 1, max 45) |
| Cardiac arrest > 24 h | 95 | 17.6 min | 44 (min 1, max 45) |

Discussion

The incidence of cardiac arrest after cardiac surgery is around 0.7-7% [8–16], EACTS, ERC and AHA endorsed resuscitation guidelines for this special group. Our survey gives an insight into current practices and adoption of guidelines of the Egyptian cardiac surgery centres. To our knowledge, there were no studies on a national level to address post cardiac surgery resuscitation practices.

In our study, 68.5% of the respondents were cardiac surgeons, of which 76.8% middle grade/resident/junior doctors. This is representative of first responders to cardiac arrest call in a routine practice thus it is crucial to identify knowledge and practices to evaluate the quality and safety of patient care. However, we found no significant differences in practices amongst respondents from various institutions, consultant and non-consultants, surgeons and non-surgeons.

Our respondents will act in a VT/VF cardiac arrest situation as follows, 75% will start CPR, 57% will give adrenaline immediately. All of which are more in line with Advanced Life Support (ALS) or Advanced Cardiac Life Support (ACLS) protocols and not the protocol dedicated for cardiac surgery.

The current guidelines advocate, once cardiac arrest is identified, to assess the rhythm first and not to commence chest compressions, reason being the possibility of presence of shockable rhythm such as VF or pulseless VT in 25-50% of cases. If a shockable rhythm is identified, chest compressions could be delayed for up to 1 min to deliver 3 shocks as this might spare the traumatic chest compressions to a fresh sternotomy wound and avoid complications of cardiac/graft injury [17, 18].

In the cardiac surgical patient, the efficacy of defibrillation reduces by 10% for every minute delay, in addition, success rates for immediate sequential shocks for VF or pVT decline from 78% with the first shock to 14% with the third, therefore, immediate defibrillation with three sequential attempts at 150 Joules is advised [19]. Whilst in severe bradycardia or asystole, it is advisable before starting

chest compressions to turn the pacing to emergency setting or DDD mode, 90 beats, maximum amplitude.

No study concluded benefit or harm of administering adrenaline during resuscitation of the postoperative cardiac surgical patient; however, the risk of administering adrenaline in conventional doses is with profound hypertension, bleeding or tearing of vessel anastomoses on return of spontaneous circulation (ROSC), which can precipitate catastrophic harm or further cardiac arrest [20]. Therefore, the recommendation to administer adrenaline is to be delayed until reversible causes of arrest are excluded and directed by a senior clinician experienced in their use. Adrenaline remains a useful drug in peri-arrest situations in smaller doses.

Of concern, almost 60% would not prefer anyone but the surgeon to perform a re sternotomy, we believe the main culprit is medicolegal claims and pursuits. Nonetheless, 17.9% would allow intensive care doctors trained for emergency sternotomy to perform it in case of cardiac arrest. This stems from the fact that junior surgeons in many Egyptian cardiac units are allocated to manage cardiac intensive care, thus, being familiar with surgical problems and have enough skills to perform an emergency sternotomy.

In total, 70.5% of respondents advocate the current guidelines for resuscitation yet only 10% train regularly. Practicing protocol-based arrest management has been shown to reduce by 50% the time to chest reopening, reduce complications resulting from the re sternotomy after cardiac surgery and improve survival [21–25]. Thus, the need to raise the awareness and training of the junior surgical doctors and intensive care staff with current guidance and emergency sternotomy protocols is paramount.

A structured national registry and regular auditing are key features to achieve the compliance, training, and monitoring of trainees; in addition, regular mandatory recertification is crucial to maintain an up-to-date knowledge of the current pool of surgeons and fellows. This could be endorsed by the cardiothoracic society body or national health service in the country.

The core message for our trainees and fellows; external chest compressions are ineffective in tamponade, extreme hypovolemia due to bleeding. Brain damage will occur in 5 min; the only way to save those patients is to perform a rapid smooth emergency re sternotomy.

Limitations

Our study has several limitations. Survey respondents are almost always self-selected, not everyone who receives a survey is likely to answer it despite offered incentives, which explains the small number of respondents. However, this was the best available alternative for multi-centre data collection due to COVID-19 pandemic and the national guidance for social distancing.

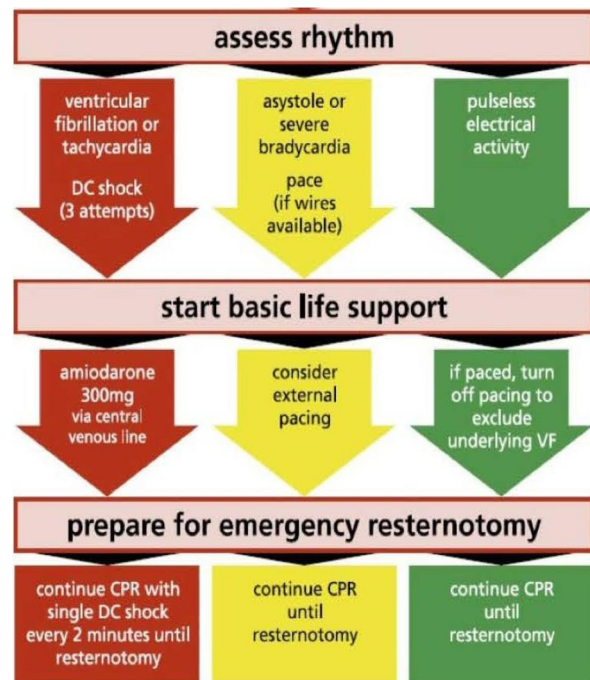
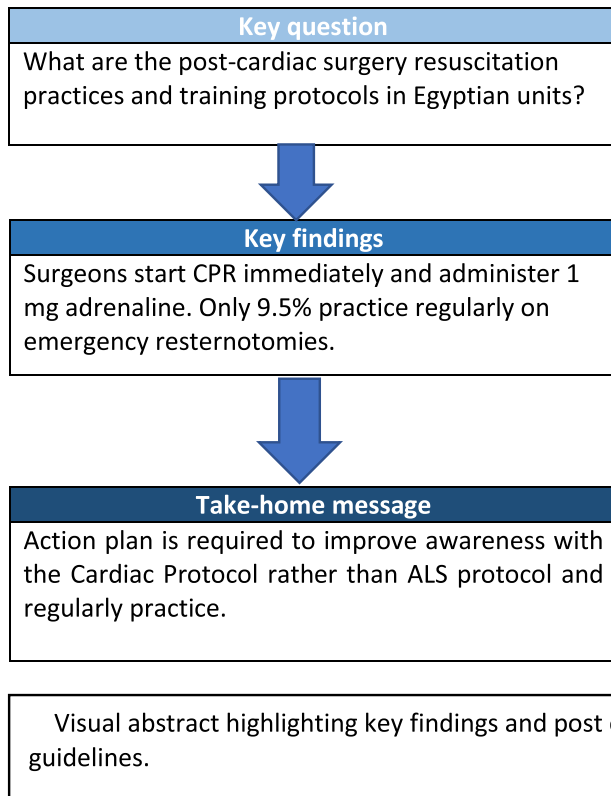
Table 3 A series of questions on the conduct of an emergency re sternotomy in patients who suffered a cardiac arrest

| | Responses | percentages |
|---|-----------|-------------|
| (6) Precordial thump (total) | 95 | |
| (a) Witnessed | 36 | 37.9% |
| (b) Heard of success | 15 | 15.8% |
| (c) Have a go | 14 | 14.7% |
| (d) Of little use | 18 | 18.9% |
| (e) Potentially harmful | 12 | 12.6% |
| (7) Defibrillation or ECM for VF | 95 | |
| (a) Immediate ECM | 72 | 75.8% |
| (b) Immediate defibrillation | 23 | 24.2% |
| (8) Sequence of shocks for VF | 95 | |
| (a) Three attempts, 2 min ECM then single shocks | 34 | 35.8% |
| (b) Single attempts with 1 min ECM | 12 | 12.6% |
| (c) Single attempts with 2 min ECM | 35 | 36.8% |
| (d) Three attempts, ECM till re sternotomy | 14 | 14.7% |
| (9) When is adrenaline warranted | 95 | |
| (a) As soon as possible | 54 | 56.8% |
| (b) After 2 min of ECM | 26 | 27.4% |
| (c) After 3-5 min after ECM | 8 | 8.4% |
| (d) Only after emergency re sternotomy | 1 | 1.1% |
| (e) Only in exceptional circumstances | 6 | 6.3% |
| (15) Emergency re sternotomy | 95 | |
| (a) A surgeon should always do this | 56 | 58.9% |
| (b) A trained non-surgeon could do this | 35 | 36.8% |
| (c) Any non-surgeons could do this | 4 | 4.2% |
| (17) Do you train for emergency re sternotomy | 95 | |
| (a) We never practise, not necessary | 14 | 14.7% |
| (b) We never practise might be good idea | 33 | 34.7% |
| (c) Informal talks and experience | 11 | 11.6% |
| (d) We have occasionally practised | 28 | 29.5% |
| (e) We regularly practise | 9 | 9.5% |
| (18) Current guidelines for the ICU | 95 | |
| (a) I advocate the ERC/AHA 2005 guidelines | 67 | 70.5% |
| (b) I do not agree with these, we have our own protocol | 1 | 1.1% |
| (c) I do not agree with these, we have no protocol | 4 | 4.2% |
| (d) I have not read the ERC/AHA guidelines | 23 | 24.2% |
| (19) Current training | 95 | |
| (a) It is adequate currently but not tailored | 17 | 17.9% |
| (b) We give additional training | 7 | 7.4% |
| (c) Tailored training might be useful | 18 | 18.9% |
| (d) Tailored training is important and should be given | 53 | 55.8% |

Data regarding the number of procedures, closed chest compressions, re sternotomy and going back on bypass rates may not represent the actual figures and numbers as 77% of the respondents are middle-grade doctors and might not be able to access these institutional numbers readily. Moreover, COVID-19 pandemic has significantly impacted the number of procedures performed and could be a valid reason for the heterogeneity of data from respondents from the same centre.

Conclusions

This is the first study on a national level to address post-cardiac surgery resuscitation, it revealed a gap in the knowledge and current practices. An action plan is required to train the junior surgeons on the Cardiac Advanced Life Support Protocol, which should be endorsed and audited by a national society or body through a national registry and mandatory recertification.



Abbreviations

ACLS: Advanced Cardiac Life Support; AHA: American Heart Association; ALS: Advanced Life Support; CPR: Cardiopulmonary resuscitation; EACTS: European Association of Cardiothoracic Surgery; ECM: External cardiac massage; ERC: European resuscitation council; ICU: Intensive care unit; ROSC: Return of spontaneous circulation; PEA: Pulseless electrical activity; STS: Society of Thoracic Surgeons; VF: Ventricular fibrillation; VT: Pulseless ventricular tachycardia.

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Authors' contributions

Moslem Abdelghafar contributed to conception, design, analysis, interpretation and writing of the work. Taher Abdelmoniem, Alaa Mohamed and Mohamed Abdalla contributed to data acquisition and revising the manuscript. All authors have read and approved the manuscript.

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Availability of data and materials

The data sets used and/or analysed during the current study are available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate

Not applicable

Consent for publication

Not applicable

Competing interests

No competing financial interests exist.

Author details

¹Department of Cardiothoracic Surgery, Wythenshawe Hospital, Manchester, UK. ²Department of Cardiac Surgery, National Heart Institute, Giza, Egypt. ³Department of Cardiothoracic Surgery, El-Hussine Hospital, Al-Azhar University, Cairo, Egypt. ⁴Department of Cardiac Surgery, Shebein El Kom Teaching Hospital, Shebein El Kom, Egypt.

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